

WHAT IS CLAIMED IS:

1 1. A method for reducing toner in an image comprised of raster pel data,
2 comprising:
3 determining surrounding pels of subject pels;
4 for each subject pel, generating a sub-pulse width power to charge a sub-pel
5 region within the subject pel based on a pattern of the surrounding pels of the subject
6 pel; and
7 for each subject pel, generating position information indicating an alignment of
8 the sub-pel region in the pel, wherein the position information is used to position the
9 sub-pel region produced by the sub-pulse width power in the pel.

1 2. The method of claim 1, wherein toner is attracted to the charged sub-
2 pel region.

1 3. The method of claim 1, wherein the position information clusters the
2 sub-pel region of adjacent pels in order to reduce electromagnetic radiation.

1 4. The method of claim 1, further comprising:
2 for each subject pel, determining whether the pattern of the surrounding pels
3 indicates that the subject pel is in a black filled region, wherein the position
4 information is used to align the sub-pel region in the subject pel in the black filled
5 region to be adjacent to the sub-pel region in one adjacent subject pel in the black
6 filled region.

1 5. The method of claim 4, wherein the alignment of the sub-pels forms a
2 checkerboard pattern.

1 6. The method of claim 1, wherein the sub-pulse width power and
2 position information is encoded in a look-up table that provides one output sub-pulse

- 1 ~~width power and position information for an input subject pel and surrounding pel pattern.~~

1 7. The method of claim 4, wherein the surrounding pels include pels from
2 the scan line including the subject pel and from scan lines adjacent to the subject pel,
3 wherein the subject pel is in the black filled region if a plurality of the surrounding
4 pels are all black.

1 8. The method of claim 7, wherein the subject pel is in the black filled
2 region if the plurality of the pels that surround the subject pel that are all black form a
3 cross shape.

1 9. The method of claim 7, wherein the surrounding pels and subject pel
2 form a data window of pels, further comprising:
3 encoding pel positions in the data window to include location information of
4 the subject pel with respect to other pels if the subject pel is in one black filled region;
5 and
6 using the position information to align the sub-pel regions in the subject pels in
7 the black filled region to be adjacent to the sub-pel region in one adjacent subject pel
8 in the black filled region.

1 10. The method of claim 9, wherein the data window forms a diamond
2 shape with the subject pel at the center of the diamond shaped window.

1 11. The method of claim 9, wherein the sub-pulse width power and
2 position information are encoded in a look-up table that provides one output value
3 including sub-pulse width power and position information for an input subject pel and
4 surrounding pel pattern, and wherein the look-up table is encoded to provide the
5 position information that is used to align sub-pel regions in pels in the black filled

- 1 ~~region to be adjacent to the sub-pel region in one adjacent subject pel for input data~~
- 2 windows that are encoded with position information.

1 12. The method of claim 7, wherein the surrounding pels and subject pel
2 form a data window of pels, further comprising, for each subject pel:
3 determining from the pels in the data window whether the subject pel is on an
4 edge of an image of black pels; and
5 using the data window as input to a look-up table that provides one output
6 sub-pulse width power and position information for different input data window
7 patterns including patterns that indicate that the subject pel is in one black filled
8 region or on one image edge.

1 13. The method of claim 12, wherein the look-up table is encoded to align
2 pels on the edge toward the black filled region.

1 14. The method of claim 12, wherein the look-up table is encoded to
2 provide a sub-pulse width power level for pels on the edge that is less than the sub-
3 pulse width power level for pels in the black filled region.

1 15. A system for reducing toner in an image comprised of raster pel data,
2 comprising:
3 means for determining surrounding pels of subject pels;
4 means for generating, for each subject pel, a sub-pulse width power to charge
5 a sub-pel region within the subject pel based on a pattern of the surrounding pels of
6 the subject pel; and
7 means for generating, for each subject pel, position information indicating an
8 alignment of the sub-pel region in the pel, wherein the position information is used to
9 position the sub-pel region produced by the sub-pulse width power in the pel.

1 16. The system of claim 15, wherein toner is attracted to the charged sub
2 pel region.

1 17. The system of claim 15, wherein the position information clusters the
2 sub-pel region of adjacent pels in order to reduce electromagnetic radiation.

1 18. The system of claim 16, further comprising:
2 means for determining, for each subject pel, whether the pattern of the
3 surrounding pels indicates that the subject pel is in a black filled region, wherein the
4 position information is used to align the sub-pel region in the subject pel in the black
5 filled region to be adjacent to the sub-pel region in one adjacent subject pel in the
6 black filled region.

1 19. The system of claim 18, wherein the alignment of the sub-pels forms a
2 checkerboard pattern.

1 20. The system of claim 15, wherein the sub-pulse width power and
2 position information is encoded in a look-up table that provides one output sub-pulse
3 width power and position information for an input subject pel and surrounding pel
4 pattern.

1 21. The system of claim 17, wherein the surrounding pels include pels
2 from the scan line including the subject pel and from scan lines adjacent to the subject
3 pel, wherein the subject pel is in the black filled region if a plurality of the
4 surrounding pels are all black.

1 22. The system of claim 21, wherein the subject pel is in the black filled
2 region if the plurality of the pels that surround the subject pel that are all black form a
3 cross shape.

1 23. ~~The system of claim 21, wherein the surrounding pels and subject pel~~
2 form a data window of pels, further comprising:
3 means for encoding pel positions in the data window to include location
4 information of the subject pel with respect to other pels if the subject pel is in one
5 black filled region; and
6 means for using the position information to align the sub-pel regions in the
7 subject pels in the black filled region to be adjacent to the sub-pel region in one
8 adjacent subject pel in the black filled region.

1 24. The system of claim 23, wherein the data window forms a diamond
2 shape with the subject pel at the center of the diamond shaped window.

1 25. The system of claim 23, wherein the sub-pulse width power and
2 position information are encoded in a look-up table that provides one output value
3 including sub-pulse width power and position information for an input subject pel and
4 surrounding pel pattern, and wherein the look-up table is encoded to provide the
5 position information that is used to align sub-pel regions in pels in the black filled
6 region to be adjacent to the sub-pel region in one adjacent subject pel for input data
7 windows that are encoded with position information.

1 26. The system of claim 21, wherein the surrounding pels and subject pel
2 form a data window of pels, further comprising, for each subject pel:
3 means for determining from the pels in the data window whether the subject
4 pel is on an edge of an image of black pels; and
5 means for using the data window as input to a look-up table that provides one
6 output sub-pulse width power and position information for different input data
7 window patterns including patterns that indicate that the subject pel is in one black
8 filled region or on one image edge.

1 27. The system of claim 26, wherein the look-up table is encoded to align
2 pels on the edge toward the black filled region.

1 28. The system of claim 26, wherein the look-up table is encoded to
2 provide a sub-pulse width power level for pels on the edge that is less than the sub-
3 pulse width power level for pels in the black filled region.

1 29. A computer-readable transmission medium including a look-up table
2 data structure used for reducing toner in an image comprised of raster pel data,
3 comprising:

4 a plurality of output values, wherein one output value is provided for at least
5 one pattern of pels including a subject pel, wherein the output value is substituted for
6 the subject pel, and wherein the output value comprises a sub-pulse width power to
7 charge a sub-pel region within the subject pel based and position information
8 indicating an alignment of the sub-pel region in the pel, wherein the position
9 information is used to position the sub-pel region produced by the sub-pulse width
10 power in the pel.

1 30. The computer-readable transmission medium of claim 29, wherein
2 toner is attracted to the charged sub-pel region.

1 31. The computer-readable transmission medium of claim 29, wherein the
2 position information clusters the sub-pel region of adjacent pels in order to reduce
3 electromagnetic radiation.

1 32. The computer-readable transmission medium of claim 29, wherein the
2 output values for subject pels in a black filled region include position information that
3 aligns the sub-pel region in the subject pels in the black filled region to be adjacent to
4 the sub-pel region in one adjacent subject pel in the black filled region.

1 33. ~~The computer-readable transmission medium of claim 32, wherein the~~
2 position information for the output values of subject pels in the black filled region
3 aligns the sub-pel regions to form a checkerboard pattern.

1 34. The computer-readable transmission medium of claim 33, wherein the
2 subject pels are in the black filled region if a plurality of the surrounding pels are all
3 black.

1 35. The computer-readable transmission medium of claim 34, wherein the
2 subject pel is in the black filled region if the plurality of the pels that surround the
3 subject pel that are all black form a cross shape.

1 36. The computer-readable transmission medium of claim 29, wherein the
2 surrounding pels for which an output value is provided in the look-up table data
3 structure form a diamond shape with the subject pel at the center of the diamond
4 shaped window.

1 37. The computer-readable transmission medium of claim 29, wherein the
2 output values for subject pels on an image edge are encoded with position information
3 to align the subject pels on the image edge toward a black filled region.

1 38. The computer-readable transmission medium of claim 29, wherein the
2 output values for subject pels on the image edge are encoded with a sub-pulse width
3 power level that is less than the sub-pulse width power level for pels in the black filled
4 region.